RTCA Special Committee 209

ATCRBS / Mode S Transponder

Meeting #4

Honeywell, Olathe KS
18 – 19 October 2006

Revised Proposed Changes to Reply Rate Capability Tests (2.3.2.2.3 and 2.4.2.2.4)

John Van Dongen
WJH FAA Technical Center

SUMMARY

This working paper is in response to the action item to revise proposed changes to the Reply Rate Capability Tests in sections 2.3.2.2.3 and 2.4.2.2.4. Changes to these test procedures were originally proposed in SC209-WP02-05.

SC209-WP02-05 contained proposed changes to the Reply Rate Capability test procedures in the Environmental Test Procedures section 2.3.2.2.3 and Detailed Test Procedures section 2.4.2.2.4. These proposed changes were not accepted as they were proposed but initiated discussion on whether or not to consolidate the Reply Rate Capability test procedures with the measurement of RF Output Power and Reply Transmission Frequency. There was an action item assigned in meeting #3 to submit a new proposal addressing these test procedures. The purpose of this paper is to propose a solution to the open issue.

Proposed Changes to Section 2.3.2.2.3

After further review, the proposed changes to include power and frequency measurements with each step of the Reply Rate Capability test are retracted. The existing test procedures are sufficient to verify these requirements under the environmental test conditions and in the detailed test procedures. The Reply Transmission Frequency test (2.3.2.2.1) measures the frequency of both ATCRBS and Mode S replies at a standard reply rate. The RF Peak Power Output test (2.3.2.2.2) measures the ATCRBS power output at the maximum reply rate for which the transponder is designed and measures the output power of a short Mode S reply at the standard rate. In addition, Step 1 of the Reply Rate Capability test (2.3.2.2.3) includes frequency and RF output power measurements with a combination of ATCRBS and Mode S replies at the maximum sustained reply rate that the transponder is required to meet and includes long Mode S replies when applicable.

There are some minor changes to the text in the test procedures identified below. These changes include corrections to the referenced requirements for some of the steps and correcting the number of ATCRBS interrogations in the Peak Reply Rate Capability tests based on the operating altitude of the equipment under test. The peak reply rate requirements for ATCRBS as a function of altitude are outlined in sections 2.2.3.4 b and 2.2.3.4 c.

2.3.2.2.3 Reply Rate Capability

Step 1 ATCRBS Reply Rate Capability (§**Error! Reference source not found.**.a and §**Error! Reference source not found.**2.~~b~~)

Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder at a constant rate of 500 ATCRBS interrogations per second plus 50 Mode S interrogations (with short replies) per second. Measure the output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 16 (24 if also equipped with the enhanced data link protocols) of the 50 Mode S interrogations requiring long replies.

Step 2 Continuous Reply Rate Capability (§**Error! Reference source not found.**.~~a~~c and §**Error! Reference source not found.**)

Set the transponder for a 14 pulse plus SPI-pulse ATCRBS reply. Interrogate the transponder at a constant rate of 500 ATCRBS interrogations per second plus 50 Mode S interrogations (with short replies) per second. If the transponder is equipped for long Mode S reply

formats, have 16 (24 if also equipped with the enhanced data link protocols) of the 50 Mode S interrogations requiring long replies. Determine reply ratio for each type of interrogation.

Step 3 100 Milliseconds Peak Reply Rate Capability (§**Error! Reference source not found.**1 b and c, and §**Error! Reference source not found.**)

Set the transponder for a 14 pulse plus SPI-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 120 ATCRBS interrogations (100 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus 18 Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 0.1-second interval, followed by a 0.9-second interval with no interrogations. If the transponder is equipped for long Mode S reply formats, have 6 (9 if also equipped with the enhanced data link protocols) of the 18 Mode S interrogations requiring long replies. Determine reply ratio for each type of interrogation.

Step 4 25 Millisecond Peak Reply Rate Capability (§**Error! Reference source not found.**)

Set the transponder for a 14 pulse plus SPI-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 30 ATCRBS interrogations (25 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus 8 Mode S interrogations (requiring short replies), each type of interrogation burst approximately uniformly spaced within a single 25-millisecond interval, followed by a 975-millisecond interval without interrogations. If the transponder is equipped for long Mode S reply formats, have 4 (6 if also equipped with the enhanced data link protocols) of the 8 Mode S interrogations requiring long replies. Determine reply ratio for each type of interrogation.

Step 5 1.6 Milliseconds Peak Reply Rate Capability (~~§2.2.3.4.1 and~~ §**Error! Reference source not found.**)

Repeat Step 3 with the following modification: Use two ATCRBS interrogations plus four Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 1.6-millisecond interval, followed by a 998.4-millisecond interval with no interrogation. If the transponder is so equipped, two of the Mode S interrogations require long replies instead of all short replies. Determine reply ratio for each type of interrogation.

Proposed Changes to Section 2.4.2.2.4

The proposed changes to the Reply Rate Capability tests in the Detailed Test Procedures are similar to those for the Environmental Test Procedures. Again there are corrections to requirements referenced in some of the test steps and there are modifications to the number of ATCRBS interrogations based on the operating altitude in the peak reply rate capability tests. In addition, each test step should include instructions to determine the reply ratio for each type of

interrogation since this is the main purpose of these tests. Power and frequency measurements are already included in these test procedures.

Reply Rate Capability

Equipment Required:

Mode S Transponder Test Set.

Measurement Procedure:

Step l Continuous Reply Rate Capability (§**Error! Reference source not found.**.aе and §**Error! Reference source not found.**)

Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder at a constant rate of 500 ATCRBS interrogations per second plus 50 Mode S interrogations (with short replies) per second. Determine reply ratio for each type of interrogation. Measure the output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 16 (24 if also equipped with the enhanced data link protocols) of the 50 Mode S interrogations requiring long replies.

Step 2 100 Milliseconds Peak Reply Rate Capability (§**Error! Reference source not found.**.b and c, and §**Error! Reference source not found.**)

Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 120 ATCRBS interrogations (100 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus 18 Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 0.1-second interval, followed by a 0.9-second interval with no interrogations. Determine reply ratio for each type of interrogation.- Measure the output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 6 (9 if also equipped with the enhanced data link protocols) of the 18 Mode S interrogations requiring long replies.

Step 3 25 Millisecond Peak Reply Rate Capability (§**Error! Reference source not found.**)

Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 30 ATCRBS interrogations (25 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus eight Mode S interrogations (requiring short replies), each type of interrogation burst approximately uniformly spaced within a single 25-millisecond interval, followed by a 975-millisecond interval without interrogations. Determine reply ratio for each type of interrogation. Measure output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 4 (6 if also equipped with the enhanced data link protocols) of the 8 Mode S interrogations requiring long replies.

Step 4 1.6 Milliseconds Peak Reply Rate Capability (~~§2.2.3.4.1 and~~ §**Error! Reference source not found.**)

Repeat Step ~~2~~3 with the following modification:

Use two ATCRBS interrogations plus four Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single l.6-millisecond interval, followed by a 998.4-millisecond interval with no interrogation. Determine reply ratio for each type of interrogation. Measure output power and frequency. If the transponder is so equipped repeat the test with two of the four Mode S interrogations having long replies.

Note: The following change was accepted in meeting 2 but does not appear in the draft DO-181D:

2.2.3.4.1 ATCRBS Reply Rate Capability

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b. If intended for installation in aircraft that operate at altitudes above 15,000 feet, the transponder shall be capable of a peak reply rate of 1,200 ATCRBS 15-pulse replies per second for a duration of 100 milliseconds.

c. If intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet, the transponder shall be capable of a peak reply rate of 1,000 ATCRBS 15-pulse replies per second for a duration of 100 milliseconds.